

Editorial

There is currently, in the physical and social sciences, a powerful shift in underlying paradigm from Newtonian-style determinism to something altogether less well behaved: complexity. Natural and man made phenomenon are, it is being understood, naturally indeterminate and the processes that govern them, non-linearly dynamic and difficult to predict. For half a century the science of the non-linear has become progressively established and refined. First there was cybernetics; then catastrophe theory, then chaos and now complexity. Variants of complexity theory have become the dominant guiding framework for knowledge advancement in all manner of domains that involve the study of individual agents who collectively display systemic behaviour that is not simply the aggregation of individual behaviour. This includes education and readers can make their own journal or Google search to sample this kind of work. In this brief editorial I want to make some rather informal but hopefully stimulating observations and comments about the complex and self-organising nature of teaching. In particular, the way in which the teacher-learner (or learner-learner since all good teachers learn as they teach) conversation evolves naturally towards an efficient exchange of ideas under certain conditions.

Let me be very selective in approach by introducing the work of a scholar, writing in the inter war and immediate post war period, who may be familiar to those who have taken courses in urban economics and geography: George Kingsley Zipf. Zipf was professor of linguistics at Harvard University and is best known for his magnum opus *Human behaviour and the principle of least effort* (Zipf, 1949). He wrote before the ground swell of interest in complexity theory, but in this work he describes the self-organising properties of language and many other transaction-based phenomena, including the organisation of the built environment and of economic activities in space.

In the opening chapters of *Human behaviour* Zipf presents linguistic data from James Joyce's novel *Ulysses* and shows that there is hidden order in the way words are arranged. The order has not been planned by the author: it is a so-called *emergent* order that has arisen spontaneously through some underlying set of low-level processes. For example, if you rank words by frequency of use in *Ulysses* (or any book) and plot frequency against rank, you get a perfectly formed inverse power relationship such that plotting the log of frequency against the log of rank gives a straight line. Words have apparently arranged themselves in *Ulysses* such that the difference in the frequency as you move down the frequency-ranked words from most common to least common, is a constant. Zipf became an influence on urban scholars because of his observation that cities in a city system display the same kind of self organisation. For many countries, the population of the second most populous city is almost exactly half the size of the largest city, the population of the 3rd ranked city is a third of the largest city, that of the 4th largest city a quarter of the largest and so on.

What has this to do with the efficiency of learner-teacher conversations? The answer is in Zipf's attempt to identify the reason for such regularities. It was a speculative and unproven justification but it is of renewed interest today given the rise in importance of the idea of transaction costs in determining order in economic and social systems. His basic idea was that there are two opposing forces that guide the evolution of language: *unification* and *diversification*. From the speaker's point of view, it is desirable in terms of effort minimisation to communicate all meaning via a single word or sound: the teenager's *grunt* for everything. For the listener, it is desirable to have a different word associated with each separate meaning: the academic pedant's endless taxonomy of technical terms. Language evolves, Zipf suggests, in a way that optimises the cost of communicative transactions between speakers and listeners. Think about recent evolutionary steps in the English language – TV rather than television, fridge not refrigerator, the aggregation of several meanings in a single word like *cool*, *wicked* and *smart* - and the idea seems plausible. Over time an evolutionary semantic balance is achieved that assigns effort to listener and speaker in a way that is broadly acceptable to society.¹

Now think about the conversations that happen in the classroom. For simplicity's sake, assume that the teacher's job is to impart knowledge to students – however that is achieved; or if you like, to facilitate students' acquisition of knowledge. An efficient language (or city) system is apparently one in which each party to an exchange can make the exchange without unreasonable effort compared to that required of the other party. There is balanced distribution of effort that facilitates efficient transactions. Zipf's evolutionary explanation of language assumes that this will only occur if the protocol of communication is subject to constant adjustment on the part of deliverers and receivers of meaning (transmitted in words).

From this premise, what might we conclude about various teaching styles? First, most traditional monologous lecturing is never likely to optimise the flow of meaning from teacher to learner. It is like insisting on the 1611 translation of the Bible authorised by King James I and set in stone for four centuries. Unless the orator is unusually gifted, students are likely to misinterpret much of what is said because they are recipients of the communication protocol, not co-designers of it. Interestingly, the traditional text book may suffer a similar weakness for the same reason: learning is a one way conversation without the chance to clarify, probe, test and re-package the teacher's meaning into words, images, illustrations and explanations that lodge easily within the student.

What teaching methods share the costs of knowledge exchange more efficiently between teacher and learner? A traditional lecturer who takes time to discover meaningful illustrations, who takes account of students' prior knowledge and seeks always to refine the presentation of arguments, the design of assignments and so on is on the right track. The

¹ With cities, economic activities and population are ordered by a spontaneous tendency to balance the opposing forces of centralisation (unification) and decentralisation (diversification). Over time, economic and social co-operation and exchange between people and firms (equivalent to conversation in linguistics) sorts and sifts activities over space in a way that produces an orderly size-distribution of settlements.

transactions that drive more efficient teaching happen in the background in this case, however, and infrequently. Student questionnaires help refine the specific pedagogic linguistics over time but the process is typically slow – a once a year conversation with a year’s time delay.

At the other extreme are the learning experiences in which students and teacher are locked in constant interaction as in studios, study visits, interactive workshops, interactive lectures or Socratic seminars. In such environments, knowledge exchange conventions, protocols and languages have a chance to develop quickly, fluidly and unpredictably.

Misunderstanding is readily identified and alternative words, metaphors and illustrations used to correct it. Teachers gain new insights from students’ own attempts to re-label phenomenon, redefine concepts and find illustrations meaningful to them. The ‘language’ developed with one cohort of students informs that used with the next and over time, words, meanings, concepts, illustrations – the elements of the teacher-learner transaction – acquire an efficiency that assigns appropriate effort to teacher and students respectively.

Ironically, approaches that strongly emphasise student-led learning such as pure forms of problem-based may be in danger of shifting the balance of effort too far to the learner. An inefficiency is introduced when students are permitted to pursue ideas or individual enquiries too far before having to submit them to the discipline of a lecturer’s experience or an established body of theory, empirical research of academic discourse. PhD learning in the UK often suffers from this kind of inefficiency.

What kind of language do we speak with our students and what steps do we take to make it an evolutionary language in which the integrity of our domain knowledge is preserved – while respecting the integrity of the student as an autonomous, complex and unpredictable learner? The intellectual fluency we impart to our students will depend in large part upon the efficiency of our classroom linguistics.

Reference

Zipf G.K., 1972 (1949), *Human Behaviour and the Principle of Least Effort: An Introduction to Human Ecology*. New York: Hafner.

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